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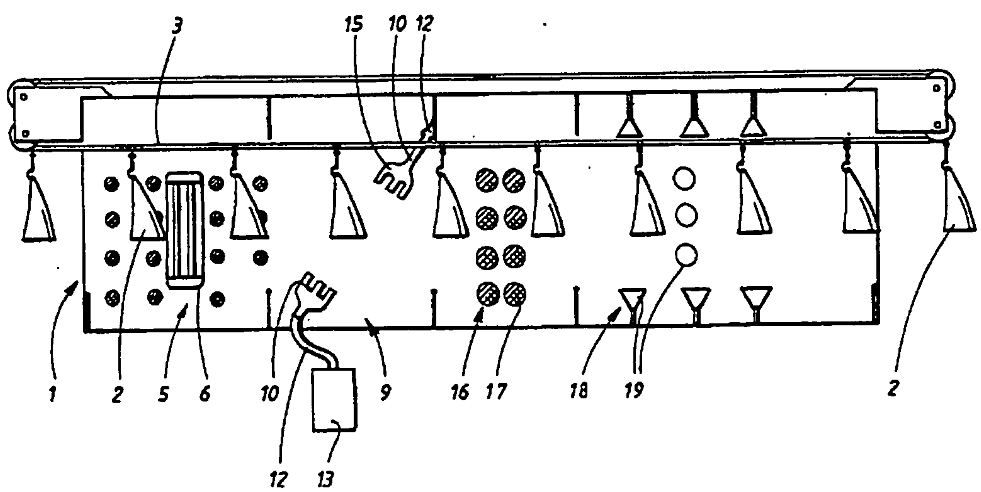

(57) Abstract

A method and a powder for powder coating in which objects (2) which are to be powder coated are prepared in order to temporarily retain the powder, whereafter the powder is applied onto the object in a layer which is retained on the object until the powder, by means of melting and transformation to a solid state by means of curing, is caused to form a coating layer on the surfaces of the object. The powder is prepared in order to have a low melting and softening temperature below about 100 °C and preferably 60-100 °C, and comprises an initiator system arranged to bring the powder material to curing under the influence of electromagnetic radiation. The powder prepared in this way is heated on the object to a temperature such that it melts and forms an adherent layer on the coated surfaces of the object. Thereafter, this layer is subjected to the radiation, thus curing it to a coating layer covering the powder-coated surfaces.

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TITLE:

Method for powder coating and powder for use in said method.

TECHNICAL FIELD:

The present invention relates to a method for powder coating and a plant for carrying out the method.

STATE OF THE ART:

Powder coating is a well known method for coating of objects. The starting material is a powdered coating, which is electrically charged and sprayed against the surfaces of the object, and which material is finally adhered and converted to a solid state by heating to its melting point. Since the powder consists of a plastic which is cured by heating, this must be brought to a comparatively high temperature, in the order of 200 °C.

The coating method may well be performed on objects having good heat resistance and a conductive surface. If the surface is non-conductive, implying that the object cannot be earthed or supplied with a charge of an opposite polarity to the charge of the powder, difficulties arise in getting the powder to adhere during the time period between the spraying and the heating to the melting temperature.

When non-conductive surfaces are concerned, the difficulties of obtaining a polarity difference between the powder and the object has in certain processes been solved by either coating the object with a conductive varnish, or subjecting it to water of such a state that a conductive moisture layer is formed on the surface. These methods have, however, attained only limited use because of disadvantages such as the fact that the coating involves an additional operation and an additional material addition, and may also give inferior adhesion than powder coating on

the clean surface and furthermore, when clear varnishes are concerned, discoloration.

The addition of water may impair the adhesion of the powder coating and damage the object by confining the applied water under the coating.

A further method of getting the powder to adhere to the surface of the non-conductive object is disclosed in DE, A1, 3 211 282 (August Albers). In said document the object having good heat resistance and mentioned to be a glass object, is heated to a temperature of 400-900 °C. This entails that the powder granules which hit the object melt and are stuck to the surface, making it possible to bring the curing process for the conversion to a homogenous, solid state, to an end. Objects which already at a lower temperature run a risk of deformation or a change in any other way cannot be treated at the high temperature required by this method. Thus, the method in question cannot be applied to e.g. objects made of wood or plastic.

SUMMARY OF THE INVENTION:

The object of the invention is to achieve a method which may be applied to powder coating of objects which are not suitable for heating to a high temperature, which may be limited to approx. 100 °C and also below. When objects having a non-conductive surface are concerned, the method may be carried out without the need for any varnishing with a conductive varnish or any addition of moisture. The method is therefore suitable when coating wooden objects, such as furniture, and objects made of a plastic which, for example for reasons of tenacity or cost, is chosen from a type providing the finished object with a surface having a different look than the one possible with the construction plastic itself. When wooden objects are concerned, the

coating may be a clear varnish which allows the structure of the wood to stand out.

According to the invention the method comprises the following main steps:

I.

Preparing a powder for the coating, said powder having a low melting point, approximately 60-100 °C and consisting of a polymer being curable by electromagnetic radiation, and in particular radiation by ultraviolet light.

II.

Preparing the object in such a way that the powder may be retained on the surface of the same until a permanent adherence has been achieved thanks to the melting and the curing of the powder. This may be achieved in different ways, individual or by interaction, and dependent on the material and the design of the object, for instance:

a) Heating the object to the melting temperature of the powder so that the powder granules adhere to the surface during melting. This may be carried out irrespective of the object having a conductive surface or not, and making use of the herein disclosed powder composition at a low temperature.

b) Spraying the powder in an atmosphere heated to such an extent that it attains its melting temperature and, in a state melted to at least a sticky state, sticks to the surface of the object.

c) Retention of the powder by electrostatic forces, thus by giving the powder an electric potential and the object a potential of an opposite polarity. This may be achieved when objects having a conductive surface are concerned.

When objects having a non-conductive surface are concerned, the surface may, as disclosed by way of introduction, be made conductive by a conductive varnish or by moistening. Also other methods of giving the object an opposite polarity are conceivable.

III.

Application of the powder, preferably by spraying while the powder particles are electrostatically charged in such a way that they achieve a good distribution in the room. However, this does not exclude application through other methods, for instance immersion in a fluidised powder bed may occur.

IV.

Heating to cause the powder particles to melt to a levelled layer and adhere to the surfaces of the object. As is evident from (IIa and b) above, the attachment of the powder to the surface of the object may be done by heating the object or the surrounding atmosphere, so that the application of the powder and the heating take place in the same operation, whereby special heating after the application of the powder is unnecessary.

V.

Exposing the object to, preferably, ultraviolet radiation, thus initiating the curing process.

From this it is evident that the method may be carried out without creating any opposite polarity between electrostatically charged powder and the object. Such a polarity difference may, however, occur and is valuable in order to get the powder distributed to all surfaces of the object, especially when of a complicated configuration. Thus, the method does not require, though does not exclude, any form of charging or neutralisation of the object, for

instance when objects made of non-conductive material are concerned, through the addition of any method disclosed by way of introduction, coating with a conductive varnish or moistening. Moreover, an electrostatic charge is attained in certain materials when they are heated, a fact which may be utilised in certain circumstances.

The invention also comprises a powder for use in the method.

DESCRIPTION OF THE DRAWINGS:
In the attached drawings there is shown, in a figure, a schematic representation of a plant for carrying out the method according to the invention.

PREFERRED EMBODIMENT:
A brief description of the method according to the invention has been disclosed in the introduction to the description. According to this the method comprises a number of main steps. These will now be described in greater detail for a certain embodiment. In said embodiment, the main steps have been complemented by a number of sub-steps in order to adapt the method to the special requirements of the embodiment.

<u>Step I : Preparation of powder</u>
The powder is composed of a polymer and may be pigmented for a coloured coating or non-pigmented for a clear coating which renders the underlying surface visible. This is something which is often aimed at when wooden objects are concerned. A principal property is that the powder should have a melting point which is lower than the temperature to which the objects, which are to be coated with the powder, should be heated. This temperature limit is partly decided by the properties of the material of the object, since the structure of certain materials changes at a temperature,

which may be fairly low, already below 100 °C when certain thermoplastics are concerned. Said temperature limit is also partly decided by the sensitivity of the object in question to deformation when heated. This sensitivity depends on the construction of the object, an object having a compact form is not as easily deformed as disc-formed or long slender objects - and also depends on how homogenous the material in the object is; certain wood species are very sensitive to deformation when heated. As a principal region for the melting point or the softening point of the powder, 60-100 °C may be specified.

As will be understood by the following description, it is not necessary for the object to be through-heated to the melting temperature of the powder, but only its surface, however to such a depth that the temperature is fairly uniformly distributed in the object, and in such a way that the temperature is retained until the powder is applied on its surface. It is not intended by the expression "the melting temperature of the powder" that the powder material has to have become fluid, but in many cases it is sufficient that it has reached such a degree of softening that it sticks to the surface intended to be coated.

The fact that only the surface has to be heated and that the temperature may be kept low is advantageous when powder coating objects which can certainly resist a higher temperature, but which anyway are disadvantageous to heat to a higher temperature. This is the case for instance with objects of a large weight, where heating to a higher temperature requires a high energy consumption. This is particularly the case when objects of a conductive material are concerned, where the heat rapidly spreads inwards. One example is solid cast iron objects. These require a considerable heating time with high energy consumption if other methods than the present are applied.

Another principal property which the powder material should possess is that its curing can be initiated by electromagnetic radiation. According to the present state of the art, especially when industrial production is concerned, it has been shown to be most advantageous to use ultraviolet (UV) radiation and to adapt the polymer powder to this. In the continued description of the embodiment UV radiation is therefore assumed. This, however, does not exclude the use of other electromagnetic radiation for the invention. In addition combinations of different types of radiation may be useful.

Good levelling at a low melting temperature may be obtained since the powder is at least partially composed of polymers such as polyester in addition to levelling agents.

Curing by ultraviolet radiation within the wavelength range 350-400 nm may be attained if polymers in a known way are admixed with initiators, or in another manner are provided with a curing system which may be activated by radiation.

These are only examples of how said properties may be attained and there are also other powder compositions which may provide the wanted properties. Without pigmentation or other dyeing, a clear layer is obtained after curing from a polymer powder which does not conceal the underlying surface. If a non-transparent layer is wished, such as opaque, white, black or coloured, pigments or other dyestuffs are added.

There is also a possibility to control the gloss of the coated surface by means of additives. If the additives produce changes in the mentioned, necessary properties, low melting point and possibility for UV curing, this must be taken into account when composing the powder and possibly also when designing the method.

Preferred composition of the polymer powder for the herein described method:
The main component of the powder is 50-<100% of an unsaturated, amorphous or crystalline, polyester. Furthermore a curing agent is preferably included in order to obtain an increased crosslinking during the course of the curing. This curing agent may to 15-50% be an aromatic urethane diacrylate oligomer, a triacrylate of trihydroxyethyl-isocyanurate, a vinyl ester, an oligomer acrylo-urethane or the like. Addition of a photoinitiator is required in order to initiate the curing sequence. This addition may vary between 1-3%. For a clear varnish it is good to use 1-hydroxy-cyclohexyl-ketone as a photoinitiator and for white pigmented systems 2,4,6-trimethylbensoyl-diphenylphosfonineoxide may be used. This is, however, only specified as an example and completely different photoinitiators may be needed for special purposes. Addition of a levelling agent is also assumed. 1-3% of this is recommended. Acrylates for example may be used as a levelling agent. Also a great number of other additives may be added, for instance in order to flatten the varnish, to avoid problems with fumes, or the like, from the object which is to be coated.

Basic recipe for a composition which is preferred for coating of wood (clear varnish) and which provides a good levelling-out after melting at low temperatures and good resistance to solvents:

Unsaturated polyester	70-85%
Curing agent	15-30%
Photoinitiator	1-3%
Levelling agent	1-3%

The melting temperature of the powder should at the most be 80-90 °C in order to ensure that a wooden component is not

damaged during the melting phase. The melting should be done by means of IR heat or with a combination of IR and convection heating. This implies that the melting phase, at such comparatively high temperatures as this, does not have to take place during a particularly long time since IR rapidly heats the wooden components to the wanted temperature. A few minutes may be assumed to be what is needed, but this is very dependent on the material which is to be coated. Certain wood materials are very sensitive to a rapid heating and may exhibit strong degassing. This may imply that a slower and more careful heating method has to be used.

After melting follows the curing procedure, see Step V. It should take place at different UV-wavelengths depending on how the varnish is pigmented and on the photoinitiator which has been added. An UV spectrum in the lower region, 200-350 nm, is convenient, whereby it is assumed that a photoinitiator which absorbs in this region is used. In white pigmented varnishes, rutile titanium dioxide is used which absorbs at these wavelengths. Consequently, another photoinitiator, which reacts to wavelengths that are not absorbed by the pigment, must be used. This requires the use of another lamp. There are lamps which have a maximum at 350-400 nm and at 400-450 nm and there are also photoinitiators which absorb at these two high wavelengths. One may also pigment an UV curing powder coating in many other ways. In each separate case the pigments must be adapted to the right photoinitiator and lamp.

High intensity lamps may imply that it is easier to cure thick layers with these and that the curing rate may be raised. The component which is to be cured does not have to be in focus, but the intensity at a certain distance may be sufficient. This is especially noticeable when clear

varnishes are concerned; for pigmented systems it is more important that the intensity be as high as possible.

Basic recipe for a composition which is better suited for coating of metal (clear varnish), and which exhibits good flexibility and adhesion to metal. Should not be used at too low a process temperature.

Unsaturated polyester	80-<100%
Curing agent	0-20%
Photoinitiators	1-3%
Levelling agent	1-3%

Also this formulation may be pigmented. The photoinitiator should be adapted accordingly.

What has been said earlier regarding radiation and radiation data is in principal also valid for the last given recipe. It should also be mentioned that, when certain compositions are concerned, photoinitiators may be replaced by other radiation susceptible initiator systems.

The given recipes are only mentioned by way of example and may be varied within wide limits, as has been disclosed, and in such a way that they may be used in the described method. Thus, powder compositions for application in the invention may start from main components other than polyester, such as epoxy-, acrylates, urethanes, melamines and others. Also, mixtures of several different polymers may be used.

<u>Step II: Preparation of the object in order to retain the powder on its surface</u>

In the embodiment IIa is applied: Heating the object which is to be coated. The object which is to be coated is assumed to have a limited heat resistance; typical of such

are wooden objects, pressed objects such as woodfibre-board or plastic objects. This includes objects made of reinforced plastics and/or objects having a high addition of filler. The fact that a material has low heat resistance, as when wood and a majority of plastics are concerned, generally also implies that it is non-conductive. Materials of high heat resistance are typically construction metals which are conductive. Conventional powder coating generally presumes objects with a conductive surface, however the present invention is not limited to such objects but may advantageously be applied also when non-conductive surfaces are concerned, and no pretreatment in order to achieve conductive properties has to occur. This makes the method particularly valuable. However, the method may also, as earlier mentioned, advantageously be applied to solid objects, e.g. cast iron bodies, in order to reduce the energy consumption for heating. The heating may occur in different ways: through convection by means of heat air flow, through infrared radiation, or in exceptional cases, when for instance plates which are to be coated only on one side are concerned, through heating by conduction from heated surfaces. Particularly useful is a method in which simultaneous heating occurs by means of convection by air flow and by means of IR radiation. The IR radiation provides a rapid and comparatively deep heating of surfaces which are hit and the air flow results in the temperature being very uniformly distributed over the surfaces of the object. This even applies for objects having a very complicated outer shape and also when the IR radiation does not reach all surface sectors. The heating is presumed to occur in a chamber, set up for the purpose, in a plant where the objects which are to be coated may be transported between different work stations intended for carrying out the method steps. See the description of the plant.

Step III: Powder spraying

As soon as the heating has been performed, the respective objects are transported to a location at which the powder may be sprayed on. This is conveniently accomplished by means of spray guns arranged in such a way that the surfaces which are to be coated may be impacted by the powder. In connection with this, it is convenient if the guns are arranged to charge the powder with an electrostatic charge. It is previously known to use a high voltage driven charging device, or that the powder, during its journey through the spraying equipment, is charged by friction against walls made of a material adapted to the purpose. The charge makes the powder granules repel each other, whereby clouds of particles are formed which encompass the object.

When the particles impact the object they will, when performing the aforementioned adaption between the heating temperature of the objects and the melting temperature of the powder, arrive in a sticky state and be deposited on the surface of the object. In this manner the respective objects receive a covering, but uncured layer of the polymer-based coating material.

Step IV: Heating to the melting temperature of the powder

As already evident, such heating is performed in connection with the application of the powder.

Complementary step: Intermediate tempering

Curing with UV radiation now remains in order to obtain a finished coating. However, it may, at least in certain cases, be convenient to regulate the condition of the applied, sticky coating layer. Such a change of the layer occurs by means of a temperature change, either cooling or heating.

In certain cases there might be a risk that the layer, in its partly dissolved, tacky state and particularly through the continued heating by means of conduction from the heated object, reaches such a fluent state that there is a risk of running and drop-forming at protruding edges. In order to prevent this, cooling may be undertaken, thus lowering the temperature which was necessary for melting the powder particles to a temperature at which the formed layer obtains a more solid state.

Alternatively, in case it is not convenient to heat the object to the temperature which the utilised powder requires for the desired melting, heating after the spraying may instead be valuable in order to lower the viscosity. In this way, the incompletely melted powder granules can be made to run together in order to form an uniform layer. If the temperature on the object has been kept low because it should not be exposed to a higher temperature, this subsequent heating must be performed in such a way that, in the main, only the applied layer is heated but not the underlying object. Thus, the heating may be undertaken by means of a rapid process involving IR radiation, conveniently in combination with a heated air flow in a short process.

In many cases there is on the whole no need for such an intermediate tempering. In that case this step is omitted.

Step V: Curing

As mentioned earlier, the polymerization of the powder material occurs by heating, as a rule in a convection oven, when conventional powder coating is concerned. Accordingly the heating at first leads to a fusion of the material while the powder granules are initially retained by means of electrostatic forces. Thereafter the curing, which is initiated by the heating, occurs.

The present method is aimed at carrying out the process at such a low temperature that no curing can be attained by means of the heating, or that in any case would require such a long time after initiation, that it would render it unfeasible in an industrial process.

Accordingly, the curing must be accomplished in another way: by initiation of the curing process by means of ultraviolet radiation. Under Step I it has been described how the powder material is prepared for such a curing.

The UV curing takes place in a specially adapted chamber into which the objects are brought after the powder spraying and the possible intermediate tempering. In the chamber a number of UV radiators are arranged, from which the radiation should reach all coated surfaces of the object. When certain objects having a complicated shape and a coating on many different sides are concerned, special arrangements might be necessary. Thus, it may be necessary to arrange a large number of UV radiators directed in different ways and they may also be supplemented with mirrors, re-directing the present radiation at new angles. Movement of the UV rays around the respective objects could also be arranged. Alternatively, the objects may be rotated or moved in another way in front of the radiation sources.

When the radiation impacts the coating layer, the initiator system of the material will start the polymerization. It is thereby possible to conduct this very rapidly - times down to 2 seconds are possible. The short processing time in relation to the time for heat curing gives important advantages when industrial production is concerned. On the one hand, a faster flow-through of work pieces and, on the other hand, a possibility to reduce the length of the plant in relation to what is required for a curing oven are attained.

The earlier mentioned intermediate tempering, particularly cooling, may take place simultaneously with the UV radiation. By means of an adapted cooling it may be prevented that the temperature during the curing reaches disadvantageously high values because of the energy contribution from the flow of heated objects and because of the UV radiation.

After Step V, the method has been completed and the objects have obtained a cured coating. Accordingly, all advantages which are associated with powder coating, namely the possibility of obtaining greater layer thicknesses and higher mechanical resistance as compared to wet varnishing, have been attained. The method is also very environmentally friendly. This is because no solvents need to be used, and powder which in the spraying step did not impact the object, may be collected in the spraying chamber in order to be reused.

A plant in which the different method steps may be carried out in a rational, industrial process is depicted in the attached drawing.

The plant shown in the drawing is in the form of a tunnel 1 through which the objects 2 which are to be treated may be passed by means of a suspended conveyor 3, the transporting portion of which is travelling in a direction from the left to the right in the drawing. In the drawing, the tunnel is shown in an opened-up state along a longitudinal section. Accordingly it is evident that it is divided into four chambers, each being adapted for the realization of one of the Steps II-V - Preparation of the powder, Step I is not included in the plant - the powder is presumed to be added in a state of preparation, ready for use in the plant.

Initially there is a chamber 5 for Step II, the heating. This chamber exhibits both radiators 6 for infrared light as well as inlet openings 7 for heated air from a combined heating and blower set.

Thereafter, a chamber 9 follows for the spraying process. Inside this a number of spray guns 10 are inserted, which via hoses 12 are connected to a powder container 13. As is shown, the spray guns may be provided with several spray nozzles 15. Through a pressurized air-driven system which is not shown in greater detail, the powder may be sucked from the container 13 up through the hose 12 to the respective gun 10 in order to be sprayed out via the nozzles 15. In this context it is assumed that inside the spray guns there are channels made of a material, for instance polytetrafluoroethylene, which by means of friction between the walls and the powder lends the latter an electrostatic charge. Alternatively, or additionally, the guns may be provided with charging surfaces which are supplied with a high voltage electrical current.

The next chamber 16 is arranged for the occasionally occurring post-tempering. It is provided with inlet openings 17 for either heated or cooled air and may also be supplied with IR radiators for complementary heating. This chamber may be omitted if, in the processes concerned, no post-tempering is presumed.

A remaining chamber 18 is adapted for step V, the curing step. A number of radiators 19 for UV radiation are placed in the chamber. As earlier mentioned, mirrors for re-directing of radiation may also be present and the walls of the chamber may conveniently be reflective.

In order to enable the temperature to be kept constant or to even achieve cooling in this chamber, it is provided

with inlet openings 22 for air. This air may be collected partly from a return line 23 from the chamber and partly from an inlet 24 from a source of air with a temperature corresponding to or lower than the lowest temperature which is assumed to be required from the cooling air through the openings 22. This source may be the ambient atmosphere if the ambient temperature is sufficiently low, or air from a refrigerating machine. Furthermore, there is an outlet 25 for air from the outlet opening 26 in the chamber, in case the discharged air is not completely going in return and in through the openings 22, but is completely or partially replaced by air from the inlet 24. The proportion between return air supplied through the openings 22 and fresh air from the inlet 25 is controlled by a thermostat-controlled throttle 27 in order to keep the temperature inside the chamber constant at the temperature most suitable for the process.

As a rule, it cannot be avoided that heat is accumulated during a continuous coating process, giving rise to a heat increase which has to be controlled, since the heated objects which are brought in provide a continuous heat contribution, simultaneously as it cannot be avoided that the radiators 19 emit a certain waste energy and the UV radiation itself gives an energy contribution. This can consequently be done by means of the described cooling system.

When carrying out the method in the described plant, the objects are in turn suspended on the transporting portion of the conveyor 3. Initially the objects are brought into the chamber 5 in turn. The conveyor moves with a speed adapted to the length of time required for the treatment step in order to obtain a sufficient retention time in the respective chambers. In the chamber 5 the objects are surrounded by heated air, blown through the openings 6 in

a smooth flow, and are exposed to IR radiation from the rays 7. This leads to a heating, well distributed over the surface of the objects, which is driven far enough to make it possible to retain the heat required for the next step.

In the chamber 9 the next step is performed, the powder spraying. It should be evident from the preceding description how this is performed with the aid of the spray guns 10. These generally have to be adapted to the object in question in terms of their positions and often also to their design, for instance the number of nozzles. In certain cases, it might be necessary to suspend the spray guns in a movable way, making them perform a movement pattern during the spraying.

If required, a complementary heat treatment is performed in the chamber 16, either cooling in order to stabilise the layer on the heated objects, or heating in order to achieve a better levelling-out of the layer sticking onto the objects.

Finally, the curing is initiated in the chamber 18 by radiation from the UV radiators 19. After the irradiation or in connection to it, a certain curing time may be required, and the chamber 18 is conveniently extended in such a way that the layer is stabilised when the objects leave the chamber. Accordingly, the radiation equipment may be differentiated along the extension of the chamber, for instance with a more intensive radiation at the inlet end of the chamber than at the outlet end.

The herein described method and plant are described as a preferred embodiment. However, other embodiments may be included within the scope of the appended claims. By way of introduction it has been mentioned that the retention of the powder applied on the surface of the object may be

accomplished in other known ways than by means of a preheating of the objects. In those cases where objects having a conductive surface are concerned, the sticking of the powder onto the objects may very conveniently be done by means of electrostatic forces, while the melting of the powder which is necessary for the process, in that case is done by means of a post-heating without the need for the objects to be preheated. Such an embodiment of the method thereby completely follows the specified main steps: Step IIc, electrostatic charging or neutralisation of the object; Step III, application of the powder; Step IV, heating to the melting temperature of the powder; and Step V, curing.

Several different methods have also been indicated for the application of the powder, of which spraying of the powder is the most useful method and has therefore been chosen in the preferred embodiment.

Consequently, the method as well as the powder composition may be adapted in a multitude of different ways to the actual requirements and types of objects which are to be treated, and to the material thereof. Common to all embodiments is, however, that melting of a powder which is fusible at a low temperature is applied, thus bringing about the formation of a polymer layer on the surface of the respective objects which are to be coated, whereafter the curing takes place by means of radiation without any substantial temperature increase. Throughout the process a temperature is thus maintained which is considerably lower than that which has previously been practised within the field.

CLAIMS:

1. Method for powder coating, in which the surface of objects (2) which are to be powder coated is prepared in order to temporarily retain the powder, whereafter the powder is applied onto the object, for instance by spraying in a layer which by means of said preparation, is retained on the object so that the powder, by means of melting of the powder and transformation to a solid state by means of curing, is caused to form a coating layer on the powder-coated surfaces of the object,
c h a r a c t e r i z e d i n that the powder is prepared in order to have a low melting and softening temperature, principally below 100 °C and preferably 60-100 °C, and in that a polymer material in the powder comprises an initiator system, arranged to bring the polymer to curing under the influence of electromagnetic radiation, and in that the powder prepared in this manner, in connection to the application on the object prepared in said fashion, is heated to such a temperature that it melts and in that this layer thereafter is exposed to the radiation, thus curing it to a coating layer covering the powder-coated surfaces.

2. Method according to claim 1,
c h a r a c t e r i z e d i n that said preparation of the surface of the objects (2) comprises heating of at least the surface layer of the object to such a temperature that a powder applied onto the object thereby reaches such a state of melting or softening that it sticks to the surface of the object until said curing by means of the radiation is carried out.

3. Method according to claim 2, c h a r a c t e r i z e d i n that the object (2) is brought to a temperature before the powder coating such that the powder melts, forming said homogenous layer across the surface of the object in such a way that the curing to a solid state may be carried out.

4. Method according to claim 2, c h a r a c t e r i z e d i n that the object (2) is heated to a temperature before the powder coating such that the powder without complete melting sticks to the surface of the object and in that, in a subsequent step, the heating of the powder occurs so that it melts and forms said homogenous layer whereafter the curing is performed.

5. Method according to claim 1, c h a r a c t e r i z e d i n that the object (2) and the powder are prepared in such a way that they obtain an electrostatically divergent polarity from each other, in that the powder is applied, preferably by means of spraying, so that it is retained electrostatically on the object, in that the powder thereafter is heated, bringing it to melting at said low temperature, and that thereafter curing by means of the radiation is performed.

6. Method according to any one of the preceding claims, c h a r a c t e r i z e d i n that the object, after the powder has reached its melting temperature, by means of tempering is maintained at a temperature such that the melting temperature of the powder is not substantially exceeded or preferably is not reached, while the curing by means of the radiation is performed.

7. Method according to any one of the preceding claims, c h a r a c t e r i z e d i n that irradiation is performed with ultraviolet light.

8. Powder for use in the method according to any one of the claims 1-7,
c h a r a c t e r i z e d i n that it is composed in order to have a melting temperature principally not exceeding 100 °C and preferably within the range 60-100 °C and in that it is curable by electromagnetic radiation, preferably ultraviolet radiation.

9. Powder according to claim 8,
c h a r a c t e r i z e d i n that it is composed of at least one polymer as a main component, a photoinitiator system for bringing the polymer to curing by means of ultraviolet radiation, and a levelling agent in order to achieve said low melting temperature.

10. Powder according to claim 9,
c h a r a c t e r i z e d i n that the main component, which preferably is an unsaturated polyester, amounts to a percentage of about 70 to close to 100%, a curing agent to at the most about 30%, photoinitiators to about 1-3% and levelling agents to about 1-3%.

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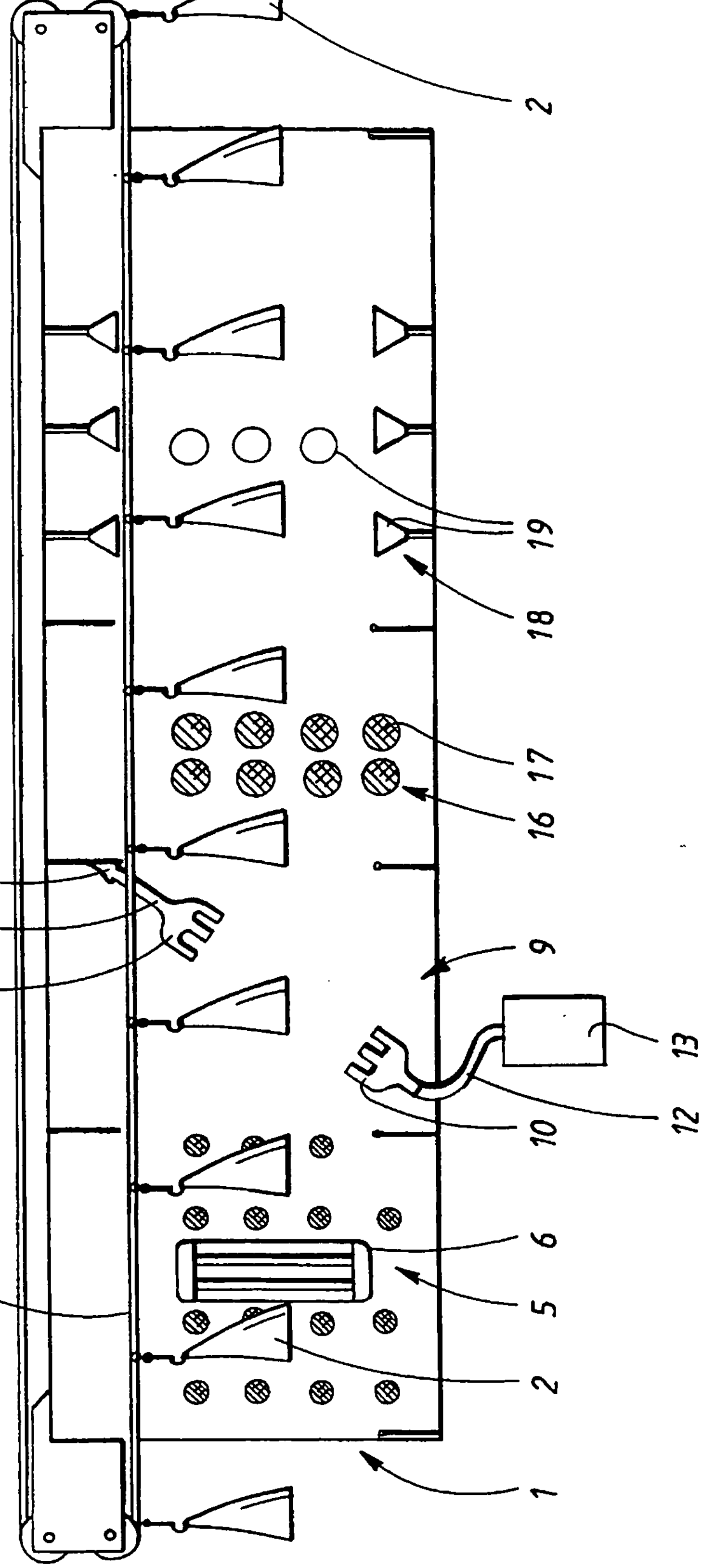

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/01003

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B05D 3/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B05B, B05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 9422596 A1 (PPG INDUSTRIES, INC.), 13 October 1994 (13.10.94), page 1, line 6 - line 14; page 2, line 5 - line 10; page 14, line 8 - page 15, line 13	1-7
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A	DE 3211282 A1 (ALBERS, AUGUST), 29 Sept 1983 (29.09.83)	1-7
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 November 1996	12 -11- 1996

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INTERNATIONAL SEARCH REPORT
Information on patent family members

28/10/96

International application No.
PCT/SE 96/01003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A1- 9422596	13/10/94	CA-A- 2156293	13/10/94
		EP-A- 0693002	24/01/96
DE-A1- 3211282	29/09/83	NONE	